

REMARKS

Claims 8-17 are cancelled. Claims 1-7 are presented for examination.

The Examiner has rejected the claims under 35 U.S.C. § 103(a) over U.S. Patent Publication No. 2003/0186110 to Sloop, or U.S. Patent No. 5,554,462 to Flandrois et al., each in view of either U.S. Patent Publication No. 2001/0028871 to Harrison et al. or U.S. Patent Publication No. 2004/0005267 to Boryta et al.

Each of the pending claims recites a lithium electrochemical cell containing between about 100 and 1500 ppm by weight of sodium. The Examiner has acknowledged that none of the primary references expressly discloses a specific sodium content, and has relied upon Harrison or Boryta to provide this missing limitation. Neither Harrison nor Boryta, however, discloses or suggests anything about the sodium content of the electrochemical cell.

Harrison, for example, is concerned with processes for the purification of lithium carbonate (see Harrison Title), and Boryta is concerned with producing lithium compounds such as lithium carbonate and lithium chloride directly from lithium-containing brines (see Boryta Title, Abstract). While lithium carbonate and lithium chloride can be used to prepare battery-grade lithium (see, e.g., Harrison Abstract), the level of sodium in battery-grade lithium says nothing about the level of sodium in the cell as a whole. The Examiner has pointed to several sections in the secondary references as supporting the allegation that the combined teachings of the references would suggest to one of ordinary skill in the art to limit the overall sodium content in an electrochemical cell to the claimed range. In doing so, however, the Examiner has mischaracterized several of the references.

The Examiner has mischaracterized the disclosure at ¶ 0005 of Harrison, stating that Harrison discloses that “high purity lithium-based components minimizes lithium’s rapid reactions with such substances... *That is, such substances are impurities including Na.*” (Office Action at page 4, emphasis original). What Harrison actually states in ¶ 0005 is that

The key to obtaining lithium of the grade required for lithium batteries is to use purified lithium chloride and carrying out electrolysis in the virtual absence of *air and humidity* to minimize lithium’s rapid reactions with these substances.

(Emphasis added). Clearly, the substances with which lithium is disclosed to react are air and humidity and not sodium. Neither sodium in particular, nor impurities generally are referenced in the paragraph, and are further not referenced to that point in the specification. Thus, sodium is not suggested in this section to be problematic in an electrochemical cell.

The Examiner has also mischaracterized the disclosure at ¶ 0007 of Harrison. The Examiner has alleged that Harrison indicates that the presence of impurities may affect the purity of lithium metal and thus affect the performance of the electrochemical cell or adversely affect the current efficiency of lithium cells. Harrison, however, actually indicates “as mentioned above, the key to obtaining high purity lithium metal is to minimize impurities such as sodium... in the lithium chloride feed to the electrolyser.” Harrison, in other words, is suggesting that sodium, if present in the lithium chloride feed, can result in a lithium metal of lower purity. The purity that is referenced prior to this in the Harrison disclosure refers to the purity of lithium carbonate (which is used to make the lithium chloride feed), and is identified as being only 99.1% lithium carbonate (see ¶ 0004). Further, Harrison at ¶ 0007 does not suggest anything about the sodium level of an electrochemical cell affecting the performance of the cell or decreasing current efficiency. Instead, Harrison discloses that the presence of “other impurities such as carbonate, sulfate and borate, which, while not significantly affecting the purity of the lithium metal produced, ...do affect the performance of the electrochemical cell.” (¶ 0007). Again, there is nothing to indicate that once formed, the lithium metal should be isolated from sodium.

Harrison at ¶ 0008 does not indicate that impurities may be deleterious for the operation of electrochemical cells, despite the Examiner's allegations to the contrary. That paragraph instead speaks to the commercial production of lithium chloride. To the extent that impurities are mentioned in this paragraph, the impurities identified are sulfates and borates. (See ¶ 0008). Once again, Harrison is not suggesting that sodium be limited in an electrochemical cell.

The Examiner has referenced the disclosure at ¶¶ 0015, 0020, 0029 and 0030 as disclosing battery grade lithium metal for use in lithium batteries. Paragraph 0015 refers only to a prior method of purifying lithium carbonate, specifically to the removal of calcium and sulfate ions. No reference is made to sodium levels. Paragraph 0020 refers generally to the sources of lithium carbonate for the commercial production of battery grade lithium, but never specifically

identifies sodium. Paragraphs 0029 and 0030 disclose that lithium carbonate from brine sources can be purified without first being transformed into lithium hydroxide. (§ 0030). Lithium metal that has maximum impurities of 100ppm Na, as required for lithium battery production, are identified.¹ Again, as noted earlier, the need for high purity lithium metal in an electrochemical cell does not lead to a need to eliminate anything but lithium metal from the cell. There is no more suggestion in Harrison, once the lithium metal is formed, to avoid sodium in the final electrochemical cell than there is to avoid other species that could be present in the electrochemical cell (e.g., the electrolyte chemicals of the instant claims). For instance, Harrison also discloses an upper limit of 100ppm iron in the lithium metal; yet this would not lead one of skill in the art to avoid using iron in lithium electrochemical cells. Similarly, it does not suggest the need to limit sodium.

Boryta has similarly been mischaracterized. Boryta discloses that “it is desirable, from a commercial standpoint, to provide a source of lithium low in sodium content because sodium becomes reactive and potentially explosive in certain chemical processes, particularly those *in production of lithium metal from lithium salts*” (§ 0004, emphasis added), not “particularly those using lithium metals” as misquoted by the Examiner. Thus, sodium is identified as potentially problematic in the specific processes of producing lithium metals from lithium salts, not because it reacts with lithium metal. Boryta does not suggest that sodium may be dangerous if present with lithium metal after the lithium metal has been formed. Boryta does indicate that sodium should be limited when forming lithium metal suitable for battery applications, but nowhere suggests that the lithium metal, once formed, should be sequestered from sodium.

As neither reference indicates that lithium metal is dangerous when exposed to sodium, and neither indicates that the performance of an electrochemical cell having lithium metal and sodium is negatively impacted, neither reference discloses or suggests a lithium electrochemical cell containing between about 100 and 1500 ppm by weight of sodium, as required by the claims.

Regarding the Examiner's response to arguments, the Applicants state the following:

¹ Applicant's note that the text of § 0030 indicates maximum impurity levels of 100ppm Na, 190ppm Na, etc. Applicants believe that this is a typographical error, and that the 190 ppm is meant to refer to calcium rather than sodium, given that it is derived from the lithium chloride that immediately follows and that identifies maximum levels of sodium (16 ppm) and calcium (31 ppm), the level of calcium in both being just under twice that of sodium. In any event, were a lithium metal to include 190 ppm sodium, this still suggests nothing regarding the overall sodium levels in the final electrochemical cell.

The secondary references disclose reasons as to why sodium should be reduced or limited in certain chemical systems or processes, none of which are electrochemical cells. Portions of the references that are cited to provide support for the Examiner's allegations that they suggest the claimed sodium content in an electrochemical cell are misquoted; the correct quotations appear above. The references do not, as alleged by the Examiner, disclose that it is recommended to reduce the concentration of sodium in lithium-based systems, but rather disclose that it is recommended to reduce sodium in lithium metal-forming processes. They do not suggest that lithium reacts rapidly and/or explosively with sodium, but rather that lithium does so with air and humidity. The Examiner is incorrect in asserting that the disclosures of Harrison and/or Boryta regarding processes used to form lithium metal are *totally extendable* to any lithium-based system or any system/product using lithium as a primary feature, as no motivation exists to so extend. The Applicants are not relying on an advantage or disadvantage of an existing configuration as grounds for patentability, but rather point to the failure of the prior art to recognize the effect of sodium in an electrochemical cell as evidence of the lack of motivation to extend the teachings of these references to the extent that the Examiner suggests they be extended.

For at least the reasons discussed above, Applicants believe that the claims are in condition for allowance, which action is requested.

Please apply any charges or credits to deposit account 06-1050, referring to attorney docket 08935-257001.

Respectfully submitted,

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